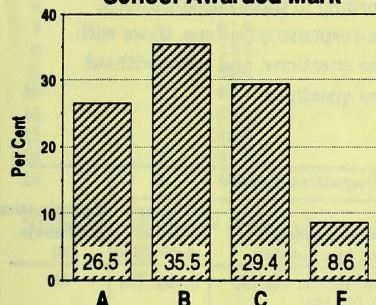


SEP 28 1992

Chemistry 30

Diploma Examination Results Examiners' Report for June 1992

School-Awarded Mark

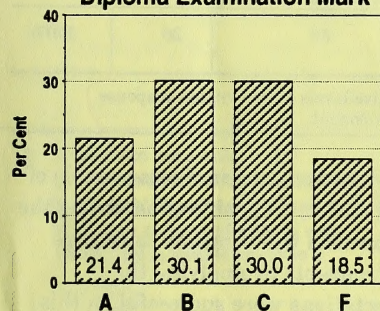


The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the June 1992 administration of the Chemistry 30 Diploma Examination. This information is most helpful when used in conjunction with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results will be available this fall.

Description of the Examination

The Chemistry 30 Diploma Examination consists of three parts: a multiple-choice section of 42 questions worth 60%, a numerical-response section of seven questions worth 10%, and a written-response section of three questions worth 30% of the total examination mark.

Diploma Examination Mark

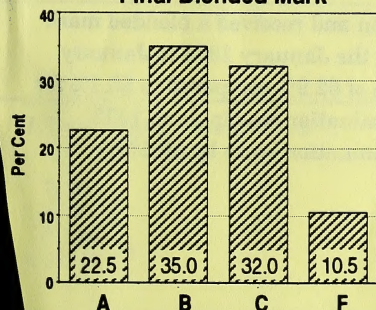


Achievement of Standards

The information reported is based on the final blended marks achieved by 8 980 students who wrote the June 1992 examination.

- 89.5% of these students achieved the acceptable standard (a final blended mark of 50% or higher).
- 22.5% of these students achieved the standard of excellence (a final blended mark of 80% or higher).

Final Blended Mark



Overall, student achievement in Chemistry 30 was acceptable, particularly in knowledge of core concepts. However, students continued to have difficulty with laboratory-related skills and processes, and in organizing and communicating their chemistry knowledge.

Provincial Averages

- The average school-awarded mark was 68.6%.
- The average diploma examination mark was 64.9%.
- The average final blended mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 67.1%.

Results and Examiners' Comments

Subtest

When analyzing detailed examination results, please bear in mind that subtest results **cannot** be directly compared.

Results are in average raw scores.

Machine scored: 33.05 out of 49

Written response: 12.3 out of 21

Course Content

• Chemical Energetics: 14.71 out of 23

• Acids and Bases: 15.58 out of 24

• Oxidation-Reduction:
15.06 out of 23

Process Skills: 22.79 out of 39

• Multiple-choice questions 3, 9, 15, 17, 20, 23, 25, 27, 29, 31, 36, and 38; numerical-response questions 2, 3, 4, 5, 6, and 7; and written-response questions 1, 2, and 3.

Cognitive Levels

• Knowledge: 14.58 out of 19

• Comprehension and Application:
24.06 out of 38

• Higher Mental Activities:
6.71 out of 13

Examination Blueprint

Each question on the examination is classified in two ways: according to the curricular content area being tested and according to the cognitive level demanded by the question. The examination blueprint illustrates the distribution of questions in June 1992 according to these classifications. Numbers with brackets [] indicate written-response questions, those with parentheses () indicate numerical-response questions, and those without brackets or parentheses are multiple-choice questions.

Reporting Category	Questions by Cognitive Level			Examination Emphasis (%)
	Knowledge	Comprehension and Application	Higher Mental Activities	
Chemical Energetics	1, 2, 4, 5, 6, 7, 13	8, 9, 10, 11, 12, 14; (1), (2); [2]	3; (3); [2]	33
Acids and Bases	15, 16, 18, 19, 22	17, 20, 21, 24, 25, 27, 28; (5); [1]	23, 26; (4); [1]	34
Oxidation-Reduction	29, 30, 33, 36, 38, 39, 40	32, 34, 35, 41, 42; (6), (7); [3]	31, 37	33
Examination Emphasis (%)	27	53	20	100%

Note: For reporting purposes, the three cognitive levels of the written-response section have been combined into one component.

This examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard will obtain a mark of 50% or higher and students capable of achieving the standard of excellence will obtain a mark of 80% or higher. Future examinations will continue to require students to demonstrate clarity in their thinking and an understanding of concepts by applying their knowledge to new and novel situations. Students who achieved these expectations were successful on this examination. The next series of diploma examinations will continue to require students to communicate their answers in a clear, concise, and organized fashion.

Approximately 11.8% of the students who wrote the June 1992 examination and received a blended mark had written at least one other Chemistry 30 Diploma Examination during the January 1991 to January 1992 period. This subpopulation (1 061) achieved an examination average of 62.9% compared to 65.1% for the population (7 919) whose first writing of a Chemistry 30 Diploma Examination was in June 1992. By rewriting, however, this group of students increased their average examination score by 10.1%.

Multiple Choice

Question	Key	Difficulty*	Question	Key	Difficulty*	Question	Key	Difficulty*
1	A	96.3	15	D	94.2	29	A	91.5
2	D	55.1	16	C	52.2	30	A	66.3
3	C	54.0	17	D	33.9	31	C	67.3
4	A	67.6	18	C	89.6	32	B	82.3
5	C	74.4	19	A	87.8	33	B	79.2
6	D	74.5	20	C	80.7	34	D	47.4
7	A	81.2	21	A	68.5	35	D	69.0
8	A	43.5	22	B	89.9	36	B	48.4
9	B	83.4	23	C	24.1	37	D	73.2
10	B	63.3	24	B	70.6	38	D	67.9
11	C	68.0	25	A	65.3	39	C	80.1
12	C	85.0	26	D	84.6	40	C	81.0
13	D	81.2	27	A	46.5	41	B	52.4
14	B	49.0	28	D	80.5	42	B	75.4

*Difficulty—percentage of students answering the question correctly

For a complete breakdown of student responses by alternative for the multiple-choice questions, please refer to the school and jurisdiction reports.

The following questions were selected for discussion because they exemplify what is required to meet the acceptable standard and the standard of excellence.

9. A substance has a molar heat of combustion of -810.4 kJ/mol . When 0.285 mol of the substance is burned in a calorimeter containing 8.60 kg of water, the increase in water temperature is

- A. 0.156°C
- B. 6.41°C
- C. 7.89°C
- D. 12.8°C

Question 9: Most students (96.4%) were able to recall or derive a method to solve this question, and 83.4% of all the students correctly did so. Of the students who answered incorrectly, most (5.7%) knew the method but were unable to manipulate the variable and as a result calculated $1/\Delta t$ rather than Δt . The other common mistake (7.1%) occurred when students divided the molar heat of combustion by the amount of the substance to calculate the total heat involved. The results for this question suggest that students attaining the acceptable standard understand fundamental concepts and are able to solve simple single-step problems involving energy transfer.

17. The weakest electrolyte would be a 0.10 mol/L solution of

- A. $\text{HCl}_{(aq)}$
- B. $\text{NaCl}_{(aq)}$
- C. $\text{NaOH}_{(aq)}$
- D. $\text{HOCl}_{(aq)}$

Question 17: Most students (96.0%) correctly recognized that the $0.10 \text{ mol/L HCl}_{(aq)}$ solution would not be the weakest electrolyte. However, many (41.7%) incorrectly selected the $0.10 \text{ mol/L NaCl}_{(aq)}$ solution as being the weakest electrolyte. This suggests that students have limited knowledge about the properties of ionic compounds or that they used test-wise procedures and selected the “one that was different”. Only 33.9% of the student population (comprising 81.7% of those achieving the standard of excellence) correctly identified the $0.10 \text{ mol/L HOCl}_{(aq)}$ solution as being the weakest electrolyte. This result suggests that those students who do not attain the standard of excellence cannot transfer their conceptual knowledge into an empirical context.

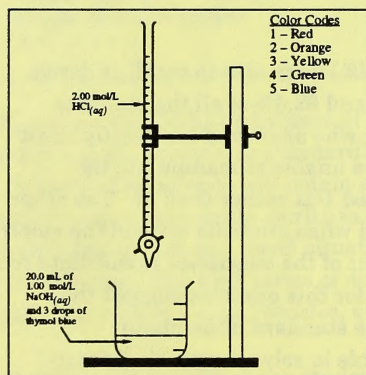
Numerical Response

Almost all students correctly followed the instructions for filling in the answer sheet. For future diploma examinations, students must ensure that their answers are recorded accurately and that, where appropriate, answers are rounded off correctly, or they will lose marks.

Question	Answer	Difficulty*
1	1.74	67.3
2	49.3	75.0
3	6.42	54.0
4	5, 5, 3, 1	15.4
5	2, 4, 3, 1	77.5
6	3.24	30.2
7	1.56	59.0

*Difficulty—percentage of students answering the question correctly

Use the following diagram and color code to answer question 4.



4. The code for the color of the solution in the beaker when

- no $\text{HCl}_{(aq)}$ is added is _____
(Record in first column)
- 5.0 mL of $\text{HCl}_{(aq)}$ are added is _____
(Record in second column)
- 10.0 mL of $\text{HCl}_{(aq)}$ are added is _____
(Record in third column)
- 15.0 mL of $\text{HCl}_{(aq)}$ are added is _____
(Record in fourth column)

The average for question 4 was 15.4%. This question discriminated well between strong and fairly strong students. The first mistake students (20.3%) made was not recognizing that initially the $1.00 \text{ mol/L NaOH}_{(aq)}$ solution containing thymol blue would be blue. An additional 29.9% of the student population failed to recognize that at the equivalence point, the solution would be yellow. Both these points did not require the student to perform any calculations. The remaining two points in the question could either be deduced or calculated. A total of 24.2% of the student population could not calculate or infer that at the second point of the titration, excess base remained and therefore the solution would stay blue. Another 10.2% of the student population was unable to recognize, deduce, or calculate that at the end of the titration, excess acid was present and that the solution would be red.

The results for this question suggest that students achieving the standard of excellence can successfully extract valid inferences from diagrammatic data and, where necessary, perform valid calculations.

Use the following information to answer question 5.

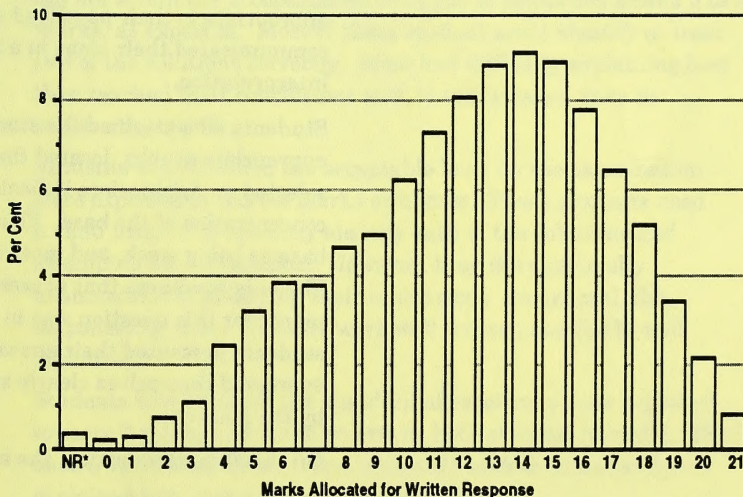
Solution	Indicator Color		
	phenolphthalein	indigo carmine	methyl orange
1	colorless	blue	red
2	pink	yellow	yellow
3	colorless	blue	yellow
4	pink	blue	yellow

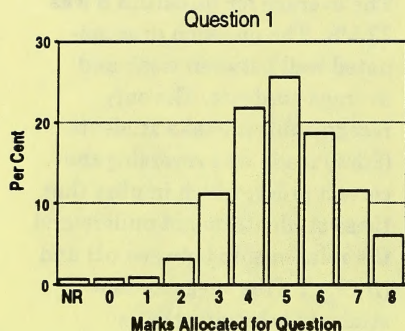
5. When these solutions are arranged from highest to lowest pH value, their numerical sequence is _____.
(Record all four digits.)

The average for question 5 was 77.5%. The question discriminated well between weak and average students. The only recognizable mistake students (9.3%) made was reversing the correct order, which implies that these students do not understand the relationship between pH and $[H_3O^+_{(aq)}]$. This suggests that students achieving the acceptable standard do so because they are capable of tasks such as using indicator colors to determine the pH of a solution.

Written Response

The level of achievement on the written-response section was better than expected: about two-thirds of the students (68.0%) achieved a mark of 11 or higher out of 21. The average mark on the written-response section was 12.3 or 58.6% of the available marks.





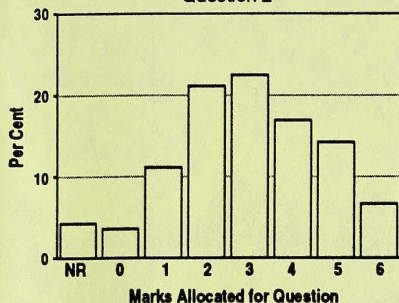
Question 1 was answered better than expected. This result was partly due to the dual purpose of the question: first, to measure students' ability to graph experimental data and, secondly, to test students' ability to extract meaningful information from the completed graph. A student who completed both could attain the standard of excellence. Students who did not meet the acceptable standard were unable to address the latter part of the question. Most of these students were able to construct a graph; however, the graphs exhibited incorrect scales, insufficient or incorrect labeling of axes, and showed evidence of "connecting the dots" rather than a smooth curve. In general, these students failed to effectively use the grid provided, and many did not indicate the equivalence point on the graph. These students also had difficulty expressing themselves. As a result, markers had to interpret their responses—which in many cases contained errors in the conventions of the communication used.

Students who attained the acceptable standard but not the standard of excellence generally had good graphing skills. These students did indicate an equivalence point; however, many marked the equivalence point as occurring at pH 7. These students had difficulty extracting information from the graph and, as a result, were unable to come up with an appropriate method of determining the concentration of the base being titrated. Many were confused about the difference between concentration and strength. They used terms such as "relatively strong, not acidic, dilute strong base, low caliber, mildly, stable base, good strength, quite big" to describe a weak base. However, these students were generally able to select an acid-base indicator appropriate to their perceived equivalence point, and they communicated their ideas in a manner that required little, if any, interpretation.

Students who attained the standard of excellence constructed appropriate graphs, located the equivalence point accurately, and selected an appropriate indicator; most could also determine the concentration of the base. These students were able to describe the base as being weak, and most were able to justify their answer. The only weakness that prevented these students from earning full marks for this question was in justifying their identification. These students presented their answers in an organized fashion and expressed themselves clearly so that no interpretation was required by the marker.

On this 8-mark question, the average mark was 4.97 or 62%.

Question 2



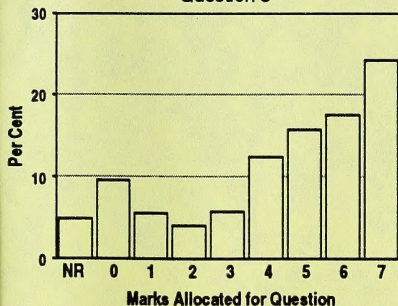
Question 2 was answered as well as expected. Students who did not attain the acceptable level on the examination had difficulty in determining the energy required both to warm and to melt the aluminum sample; many calculated one or the other. These students gave confused answers for part b: they either wrote several advantages and no disadvantages, or they failed to indicate which was which. Most of the responses by these students were poorly organized and communicated.

Students who attained the acceptable level on the examination correctly determined the amount of energy required to warm and melt the 16.1 g sample. Most were able to state an advantage, a disadvantage, and a conclusion about recycling. However, these students did not do a valid energy comparison when it came to justifying their position. The most common mistake was in comparing the energy required to warm and melt 16.1 g of aluminum with the energy required to form 1 g of aluminum by electrolysis. The majority of the responses to part a were well organized and easy to follow. For part b, the responses tended to ramble.

Students who attained the standard of excellence clearly communicated their answers. They had no difficulty determining the amount of energy required to warm and melt the aluminum sample, nor did these students have difficulty in stating an advantage, a disadvantage, a position, or in supporting their position with a valid comparison.

On this 6-mark question, the average mark was 2.98 or 50%.

Question 3



Question 3 was answered better than expected. Students who did not attain the acceptable level on the examination scored 0 to 3 marks, as expected. Most of these student could identify at least two of the solutions correctly. Most had difficulty explaining how they reached their conclusions and, in many cases, gave no explanation at all.

Students who attained the acceptable level on the examination were expected to score 4 marks or higher. These students used a valid method to correctly identify each of the solutions and attempted an explanation. However, they were generally unsuccessful in justifying their conclusions. In general, the responses by these students were well written and fairly well organized.

Students who attained the standard of excellence were expected to score 7 marks and make no errors, both of which they did. They used a valid method to correctly identify each solution, and they explained how they reached each identification.

On this 7-mark question, the average mark was 4.35 or 62%.

For further information, contact Don Loerke, Lowell Hackman, or Phill Campbell at the Student Evaluation Branch, 427-2948.

